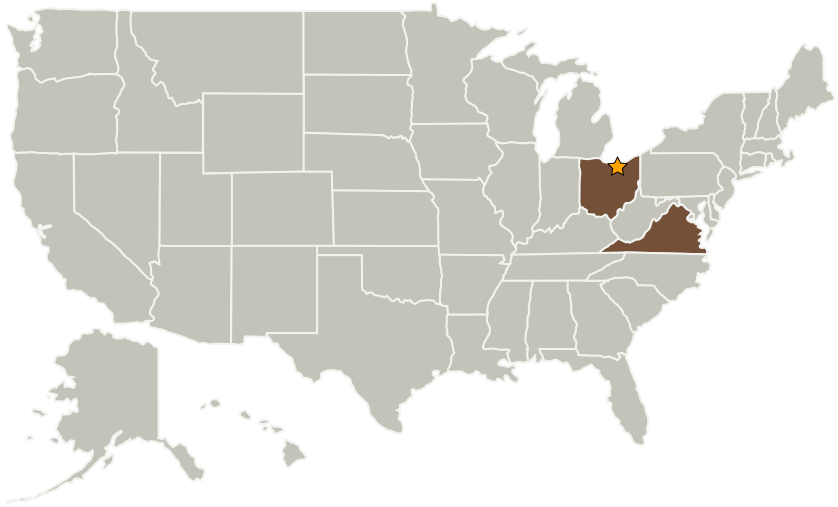
Ultrasonic Derivative Measurements of Bone Strain During Exercise, Phase I

Completed Technology Project (2005 - 2005)

Project Introduction

Luna Innovations, Inc., in collaboration with the SUNY Stony Brook, proposes to extend ultrasonic pulsed phase locked loop (PPLL) derivative measurements to the noninvasive assessment of bone strain during exercise. The PPLL is a high-resolution ultrasonic spectrometer that measures changes in natural velocity with parts in ten million accuracy. With this resolution, the PPLL can be used to measure a material's nonlinear elastic constants, which are related to changes in the speed of sound as it is loaded. Nonlinear elastic constants are more closely linked to bone strength than traditional absolute measurements of the speed of sound, thus providing an important new capability for bone health assessment. This technology has been demonstrated on a number of engineered materials, including fasteners, heat-treated aluminum, heat-treated steel, composite materials, railroad rails, and adhesive bonds. In Phase ILuna's PPLL technology will be tested on bone ex vivo at Stony Brook's Biomedical Engineering Department to develop a strong physics-based model of how natural velocity changes as a bone sample is loaded. This research will lay the groundwork for Phase II, in which Luna's PPLL technology will be combined with Stony Brook's scanning confocal acoustic diagnostic (SCAD) technology for in vivo studies.

Primary U.S. Work Locations and Key Partners



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Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Center / Facility:

Glenn Research Center (GRC)

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

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Organizations Performing Work	Role	Type	Location
★Glenn Research Center(GRC)	Lead Organization	NASA Center	Cleveland, Ohio
Luna Innovations, Inc.	Supporting Organization	Industry	Roanoke, Virginia

Primary U.S. Work Locations	
Ohio	Virginia

Project Management

Program Director:

Jason L Kessler

Program Manager:

Carlos Torrez

Principal Investigator:

John T Lynch

Technology Areas

Primary:

- TX12 Materials, Structures, Mechanical Systems, and Manufacturing
  - TX12.3 Mechanical Systems
    - TX12.3.4 Reliability, Life Assessment, and Health Monitoring